

# **EXECUTIVE SUMMARY Of DPR for Port & IWT**

## **1.0 INTRODUCTION**

### **1.1 Existing Transport Network**

North Eastern region of India comprises of seven states viz., Assam, Meghalaya, Manipur, Tripura, Nagaland, Arunachal Pradesh and Mizoram. This region is connected by land with the rest of India through West Bengal. The surface transport system for movement of cargo/passengers to and from the northeastern states consists of road, rail and waterways. As far as cargo movement is concerned, most of the cargo originates from Kolkata and terminates at Guwahati and vice-versa. From Guwahati, the cargo gets distributed to various destinations of northeastern states. The transport links to states particularly Mizoram, Tripura, Manipur and Nagaland are affected many a time by floods, land slides, blockages of roads and local agitations.

### **1.2 Proposed Transport Network**

Inland Water Transport (IWT) is an important mode of transport in India and Myanmar since time immemorial. Both the countries are gifted with natural rivers, streams, estuaries and backwaters to develop navigation. Some of the waterways have direct access to the sea where the transport system can be linked to sea routes. The river Kaladan is one such waterway where the IWT can be integrated with shipping to form a transport link. Through this transport link, the cargo can be transported from Kolkata Port or other ports of India to Sittwe Port by sea and from Sittwe port to Mizoram state by IWT/Highway and vice-versa. The proposed transport system can also be used for border trade between India and Myanmar.

RITES had conducted technical feasibility study for IWT on river Kaladan and Highway along the river Kaladan from Sittwe to India-Myanmar border (Mizoram) during 1999-2000 and report was submitted to the Ministry of External Affairs (MEA), in March,2001. This technical feasibility study identified the following transport links.

- Kolkata Port in India to Sittwe Port in Myanmar by sea route.
- Sittwe Port in Myanmar to Sitpitpyin (Keletwa) waterway along River Kaladan.
- Sitpitpyin in Myanmar to Mizoram in India by Highway.

The transport links will require the following new developments:

- Development of Kaladan waterway from Sittwe to Sitpitpyin (Kaletwa) – 225 km by undertaking river engineering works such as dredging, removal of rock out-crops/rapids, navigation aids etc.

- Construction of a new port terminal and infrastructure facilities at Sittwe for transshipment from ships to IWT vessels.
- Construction of IWT / Highway transshipment terminal at Sitpitpyin (Kaletwa)
- Procurement of IWT Vessel

This DPR study details the above identified works for further execution of the project.

## **2.0 SURVEYS AND INVESTIGATIONS**

### **2.1 Hydrographic Survey**

Hydrographic surveys were carried out at Sittwe Port and along the proposed waterway. The Sittwe port survey data was required to compute dredging in harbour and approach channel. The river survey was for studying the navigability of IWT vessel.

### **2.2 Navigability in the River**

Detailed hydrographic surveys are hydrological investigations for Sittwe port terminal development and for Waterway development from Sittwe port to Sitpitpyin (Kaletwa) were carried out from February, 2002 to April, 2002.

The river reach between Sittwe and Paletwa (158.5 kms) is under the influence of the sea. The seawater enters freely through the river confluence at Sittwe. The tidal range at Sittwe is 2.6m, whereas the tidal range at Paletwa is 0.9. The tidal range progressively decreases upstream of the river and becomes 0.4 at Numbu (186.5 km from Sittwe) and further upstream the sea influence ceases. The river flow upstream of Numbu upto Sitpitpyin (Kaletwa) and beyond depends upon the fresh water discharges. The availability of depths for navigation in this fresh water reach of the river depends the seasonal variation of the water levels. As there is no historical long period water level data available on this river, to assess the feasibility of round the year navigation the water level data collected during the Feasibility and Detailed Project Study periods is used as the basis. The analysis of the water level data indicates that from May to October (about 6 months) adequate water will be available for navigation. From November to December the water levels in the river recede and navigation is possibly by implementing river conservancy works. The period from January to April is considered as lean period and water levels reduce drastically. During these months (January to April), the navigation in the upstream reaches is difficult due to non-availability of adequate discharges in the river. It is reported that the lean period discharges of the river in the upstream reaches are of the order of 20 cumecs. There is a proposal to construct a Hydro Electric Project on river Kolodyne in Mizoram, about 67 km upstream of the India-Myanmar border, the implementation of which would ensure lean period discharges to the down stream of the river of the order of 80 cumecs. This will improve the down stream navigation on river Kaladan particularly during lean period.

The bathymetric surveys were carried out in the sea for approach channel to the Sittwe Port and for development of port terminals. The hydrographic and topographic surveys have also been carried out on river Kaladan from Sittwe to Sitpitpyin (Kaletwa) with a special emphasis to demarcate the shoals and rock obstructions. The surveys were carried out using the state-of-art equipment like dual frequency echo sounder, 'Echotrac', Real Time Differential Global Positioning System (DGPS), and Auto Level. The hydrographic surveys show that the river is wide between Sittwe and Paletwa and the width varies from 8,800 m to 175 m and the least available depths are around 2.2 to 2.5 m below chart datum except at Langaddoo shoal where the depths are around 1.5 m. Between Paletwa and Sitpitpyin (Kaletwa), the widths are reduced and range from 250 m to 75 m and the predominant depths are around 1.5 to 1.0 m below low water level.

Apart from the limiting depths and widths of the river in the upstream reaches, the waterway encounters rapids, rock out crops and boulder, which pose problems for navigation. The blockage of the river by boulders at Taung Bro due to landslide also requires to be removed to ensure navigation through this stretch. The formations of the rock are predominantly composed of fine to medium grained sandstone and hardness is 3 to 4 in Moh's scale. The Uniaxial Compressive strength of the rocks varies between 16 and 40 Mpa. Suitable techniques for removal of rock obstructions have been suggested in the report.

### **2.3 Geo Technical Investigation**

Geo-technical investigations have been carried out at the proposed terminal locations at Sittwe and Sitpitpyin (Kaletwa). Four numbers of boreholes were drilled at each of the proposed locations to identify the soil characteristics.

### **2.4 Numerical Model Studies**

Numerical model studies have been conducted to predict the wave characteristics at the proposed Sittwe port terminal by wave hind cast technique using the wind data. The estimated significant wave height near the Sittwe Port varied between 0.1 and 1.0 m. with an average value of 0.2 m over the year. About 94% of the time the significant wave height is less than 0.4 m. The average wave period varied between 1 and 5.5 with an average value of 3.5. The wave direction near the coast is mainly perpendicular to the coastline due to the refraction effects. The coastal inclination at the study region is  $20^{\circ}$  with respect to north. Hence, the wave direction varies between  $90^{\circ}$  and  $130^{\circ}$  for the study region. The significant wave heights for return periods of 5 to 100 years in the harbour area are given in the report.

Numerical model studies on river Kaladan have been carried out to study the river course in response to implementation of river training measures such as dredging and rock removal. The model was run for two scenarios i) 20 cumecs discharge – critical discharge during lean period without any Hydro Electric Project on the

upstream reach and ii) 80 cumecs discharge – ensured lean period discharge, after the construction of Hydro Electric Project. The model run with 20 cumecs discharge has demonstrated that the design channel will be ensured for 2.0 m depth from Paletwa to Taung Bro (195 km chainage) and 1.5 m depth will prevail from Taung Bro to Sitpitpyin/Kaletwa (225 km chainage). On the other hand, more than 2.0 m depth in the design channel will be ensured throughout the reach if 80 cumecs discharge is available.

### 3.0 WATERWAY

#### 3.1 Approach channel to Sittwe port

The design of the approach channel to Sittwe Port is based on the anticipated size of general cargo vessels. The size of the vessel considered for initial development is 6000 DWT. The channel dimensions for this vessel are as follows:

Channel	6000 DWT (16.9 m beam)
Width at draft level	59.15 m
Bed width	52.15 m
Depth below CD	7.9 m
Side slopes	1:5
Full loaded draft	7.2 m

#### 3.2 Waterway channel

The results of the hydrographic surveys, hydraulic investigations and numerical model studies have revealed that the limiting depths and widths of the waterway during lean period and the existing rapid, boulders and rock out crops are the major bottlenecks for navigation.

Keeping in view the above constraints, the following channel dimensions for the waterway are proposed

Channel	Dimension
Top width	57.5 m
Width at draft level	42.5 m
Bed width	37.5 m
Depth below C.D (LWL)	2.0 m
Side slope	1:5

For removal of shoals, rapids, boulders and rock the following techniques are proposed

- Dredging
- Normal blasting for exposed rocks
- Drilling and blasting for submerged boulders and rock out crops
- Plaster shooting of small rapids

For development of the recommended approach channel to Sittwe Port and Kaladan waterway, particularly from Paletwa to Sitpitpyin in channel improvement works such as dredging of shoals, rock blasting for removal of rapids, boulders and rock out crops are required to be undertaken and quantities for such works have been worked.

Dredging quantities in cu m		
Sea dredging (soft material)	River dredging	
	Soft and coarse material	Rock
561,954	1,683,886	330,746

Apart from the channel developmental works, certain aids to navigations such as navigational buoys/marks covered with sheets of adhesive scotchlite or luminous paint, search light etc. have been recommended to identify the fairway and danger locations of rapids and rock out crops.

#### 4.0 SELECTION OF VESSEL

##### 4.1 Navigation Route

The proposed navigational route from Kolkata to Myanmar is as follows:

1. From Kolkata Port to Sittwe Port by voyage in open sea (539 km or 291 nautical miles)
2. From Sittwe Port to Sitpitpyin (Kaletwa) in Myanmar by IWT on Kaladan river (225 km)

In view of the two distinctly different nature of navigational routes, two types of vessels (i) Sea Vessel and (ii) IWT Vessel will be needed for transportation of cargo.

##### 4.2 Choice of Vessel for Sea Transportation

For transportation of cargo from Kolkata Port or any other Port of India to Sittwe Port, various alternatives of sea vessels, such as 6000 DWT, 10,000 DWT, 15,000 DWT and 20,000 DWT, have been discussed. The initial development is proposed with 6,000 DWT vessels in order to minimize the cost of capital dredging. However, the berthing structure proposed is suitable to handle vessels up to 20,000 DWT to cater to the ultimate stage of development. The characteristic of 6000 DWT general cargo vessel is as given below.

Sea Vessel	Carrying capacity in tons	Overall length (m)	Moulded breadth (m)	Moulded depth (m)	Full load draft (m)
Kolkata to Sittwe	6000 DWT	124	16.9	9.5	7.2

### 4.3 Choice of IWT Vessel

For transportation of cargo from Sittwe port to Sitpitpyin on river Kaladan in Myanmar various alternatives of IWT vessels have been discussed. Keeping in view of the limiting depths, rapids and rock out crops in the upper reaches of the waterways, the following self-propelled vessel has been recommended with a transshipment point to highway mode at Sitpitpyin/Kaletwa.

<b>River Reach</b>	<b>Carrying capacity in tons</b>	<b>Overall length (m)</b>	<b>Moulded breadth (m)</b>	<b>Moulded depth (m)</b>	<b>Full load draft (m)</b>	<b>Speed Kmph</b>
Sittwe to Kaletwa (225 km)	260	40	8.5	2.3	1.5	16.8

In view of the low depths during the lean period the vessel will be partially loaded to negotiable the upper reaches of the waterway as indicated below:

<b>Month</b>	<b>Ensured depth below low water level</b>	<b>Draft</b>	<b>Cargo carrying capacity</b>
May to October	2.0	1.5 m	260 tons
November to April	1.5 m	1.0 m	120 tons

### 4.4 IWT Fleet Requirement

The requirement of number of vessels has been worked for the assumed general cargo throughputs of i) 50,000 tons ii) 100,000 tons and 150,000 tons per annum. The number of working days for operation of the transport system is considered as 300 days in a year to allow down time for monsoons, lean period, annual repair and maintenance etc. Around 10 vessels are recommended initially for the cargo throughout of 75,000 tons. It is compatible with the capacity of IWT terminal at Sitpitpyin.

## 5.0 PORT AND IWT TERMINALS

### 5.1 Terminal at Sittwe

The port jetty is provided with a level luffing type of crane for loading/unloading operations. The rated capacity of the crane is 10 T with a maximum outreach of 25.5 meters with hook attachment suitable for the general cargo vessels anticipated to be handled at Sittwe Port.

Similarly, for loading/unloading operations at the IWT jetty in Sittwe terminal, a mobile tyre mounted crane of 25 tonnes and rated capacity with maximum outreach of 12 meters, with outriggers is proposed for handling operations.

In order to achieve the required productivity as well as efficient handling operations at the jetty the small break-bulk cargos will be gathered together, pre-slinged and handled.

Such pre-slinging of cargo improves the average handling rate. At this terminal, it is proposed to have (2) two jetties to meet the Port & IWT requirements with one berth exclusively planned for general cargo operations at the port and the other for dedicated IWT operations.

The physical dimensions of the proposed port jetty is based on the design general cargo vessel size of 20,000 DWT (anticipated in future) with full draft requirement of 9.5 meters. Hence, the length of port jetty proposed is 219 meters with an apron width of 15.2 meters, suitable for installation of a rail mounted level luffing crane for handling general cargo.

Similarly, IWT jetty is planned and designed for the proposed designed IWT vessel of 260 Tonnes, for which the length of the IWT jetty provided is 54 meters with an apron width of 15.2 meters.

The facilities proposed at the Port terminal back-up area are the following:

- Two Covered transit storage sheds of (24mX 36m) with suitable partitions for food grains, fertilizer and other agricultural products and cement.
- Provision for future covered storage area of (24mX36m) for Cement, and Food grains.
- Open storage area of (40m X 30m) for Timber logs.

Similarly, the following facilities are proposed to be located in the back up area of IWT terminal:

- One Covered storage shed of (24mX36m) with adequate partition walls for segregating commodities such as food grains and other Agricultural products.
- Open storage area of (20m X 30m) for Iron & Steel, commodities such as machinery & other miscellaneous general cargo.
- Truck parking area of 20 x 25 m.

In addition to the above, the terminal facilities include office space, electrical room, as well as watch & ward office. The terminal back-up area requirements include provision of internal roads, general area lighting, and compound wall and gate complex. The back-up area requirement is 240 m x 120 m for the development proposed, which can be further expanded to 495m x 120m in the future.

## 5.2 Terminal at Sitpitpyin

The back up facilities for the terminal are proposed at the flat land (+36 m level). The jetty is proposed to be connected to the backup area, through an approach with a length of 222 meters resulting in 10% gradient which is generally considered acceptable for short stretches with low vehicular movement in case of difficult terrain for economy.

The physical dimensions of the proposed IWT jetty is based on selected design vessel of 260 tonnes capacity.

The length of jetty is 54 meters with an apron width of 15 meters for loading/unloading operations with adequate provision for the turning of the trucks on the jetty. The approach comprises 192 meters length of concrete piled structure up to +33.725 m (above HFWL) and 30 meters of road up to back up area at +36 m.

For loading / unloading operations at Sitpitpyin terminal a mobile tyre mounted crane with outriggers is proposed. The rated capacity of the crane is 25 tonnes with a maximum outreach of 12 meters.

The facilities proposed at the IWT terminal back-up area are as follows:

- One covered transit storage shed of 23 m X 36 m with suitable partitions for segregation of commodities.
- An open storage area of 30 m X 20 m.
- A truck parking area of 50 m X 12 m.
- Area for future development.
- In addition to the above the terminal facilities include office space, electrical room, generator room, rest room and security office.
- The terminal back-up area development also covers provision of internal roads, general area lighting, security compound and gate complex. The back-up area requirement is 170 m X 100 m for the development proposed, which can be further expanded to 300 m X 100 m in future.

## **6.0 COST ESTIMATES**

### **6.1 Capital Cost for Development of the System**

The transportation of cargo from Indian ports (origin / destination) to Mizoram (destination / origin) and vis-à-vis requires development of following components in Myanmar and border areas in Mizoram as described above.

- Port and IWT terminal at Sittwe Port including development of approach channel, cargo handling facilities for transfer of cargo from sea going vessels to IWT vessels.
- Waterway along river Kaladan a part of the waterway from Sittwe to Paletwa is available as natural waterway with minimum developmental works while the balance waterway has to be developed through river conservancy measures such as deepening by dredging / clearing of landslide boulders, navigational aids etc.
- Terminal at Sitpitpyin (Kaletwa) to transfer the cargo from IWT mode to Highway mode.

The total capital cost of development of Kaladan Waterway between Sittwe and Kaletwa, construction of Sittwe port and IWT terminals and procurement of IWT vessels (10 nos.) is estimated to be US\$ 68.24 million.